

Prediction of Combined Mesiodistal Width of Unerupted Permanent Canine and Premolars using Moyer's Mixed Dentition Analysis in Nepalese Newar Population

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ABSTRACT

Introduction: Moyer's probability table is most commonly used to predict the mesiodistal width of permanent canines and premolars in mixed dentition. However, the table was formulated using data from Caucasian population. This study was performed to compare the Moyer's prediction table with actual value in Nepalese Newar population as ethnicity is one of the important factor to determine teeth width.

Materials & Method: Combined mesiodistal width of permanent canine and premolars were measured in 150 study models of Nepalese Newar orthodontic patients (75males and 75 females). The value was compared with the Moyer's prediction table at all probability level.

Result: There was no statistically significant difference between the actual combined width and that predicted from Moyer's table at 85% probability level for maxilla and at 75% level for mandible in male, at 95% probability level for maxilla and at 85% probability level for mandible in female.

Conclusion: Moyer's probability level can be used to predict the combined mesiodistal width of permanent canines and premolars in Nepalese Newar population but at specific probability level.

Keywords: Analysis, Mixed dentition, M-D width, Moyer's chart

INTRODUCTION

Crowding of teeth is one of the main reason for patients seeking orthodontic treatment¹⁻³ as it is unesthetic and maintenance of oral hygiene also becomes difficult. If it can be diagnosed early during mixed dentition stage, intervention can be done to treat or to reduce its severity. Crowding or spacing occurs due to arch length tooth material discrepancy and we have various methods available to analyze such discrepancy.^{4,5} Mixed dentition space analysis can be done to predict the future requirement of space for permanent teeth so that intervention can be done to reduce the severity of malocclusion.^{5,6}

Moyers probability table is available to predict the combined width of permanent canine and premolars for both maxilla and mandible on the basis of mandibular permanent incisors.⁷ The sample details and regression equation used to establish the probability table are not clear in literature. According to Proffit and Fields¹ Moyer's table is fairly applicable for northern European whites on which the data was

based but does not accurately predict for other races.⁸⁻¹²

There have been two reported studies done on Nepalese population to predict the width of permanent canine and premolars.^{10,11} Both studies found inaccuracy of the Moyer's prediction table when applied in Nepalese population.

Nepal is a country of ethnic diversity and Jaiswal et al¹⁰ did not take ethnic diversity into consideration and Gyawali et al¹¹ did study on Nepalese Brahmin and chhetri only. Newar community form 6th largest population of the country comprising 5.4% of total population¹³ and although they are spread throughout the country but are mainly concentrated in Kathmandu Valley. This study aims to test the applicability of Moyer's mixed dentition analysis for Newar community in Kathmandu valley.

MATERIALS AND METHOD

This is a cross-sectional analytical study conducted in Department of Orthodontics and Dentofacial

Orthopedics, Kathmandu Medical College – BDS program, Bhaktapur, Nepal. Study models prepared as a diagnostic record for Newar patients seeking orthodontic treatment were taken as sample.

The inclusion criteria were:

- Nepalese Newar of minimum of 14 years of age
- Fully erupted permanent teeth up to 1st molar on both maxilla and mandible (2nd and 3rd molars are not considered)

The exclusion criteria were:

- Interproximal caries or restoration
- Malformation of teeth
- Attrition or abrasion
- history of orthodontic treatment
- history of trauma to jaw or teeth

Total of 150 (75 males and 75 females) samples meeting all inclusion criteria were taken for the study. Mesiodistal width of mandibular incisors, maxillary and mandibular canines and premolars were measured in natural light⁵ using digital Vernier caliper of 0.01 mm accuracy. Maximum mesiodistal widths of crowns of each tooth were measured at right angle to long axis of the individual tooth^{5,8} with caliper beaks entering either from buccal or occlusal, preferably buccal unless tooth was rotated. Test retest reliability was done in two weeks' interval for all sample. A third measurement was done for variation of more than 0.2mm. Variation of 0.2mm or less in repeat measurements were averaged.^{10,14} All the measurements were done by single investigator. Collected Data were analysed using IBM SPSS Statistics 20.

RESULT

Independent sample t-test was performed on mesiodistal dimension of teeth on right and left and it was found to be statistically insignificant for both male and female. Thus the further calculations were done taking mean for right and left.

Sum of mesiodistal width of mandibular four incisors (CWI), maxillary canine and premolars (UCW) and mandibular canine and premolars (LCW) were obtained. Independent sample t-test showed statistically significant gender variation for CWI, UCW

and LCW, male having larger values as shown in table 1.

Paired sample t-test was done to find whether significant difference existed between the actual combined width of canine and first and second premolars and the predicted width using Moyer's table at different probability level for both male and female. Result is summarized in table 2 and 3. In male, Moyer's table underestimated the actual size of canine and premolars at all probability levels except at 95% level where it overestimated for maxilla and at 95% and 85% for mandible, and the difference was statistically insignificant at 85% level for maxilla and 75% for mandible. Also in female, it underestimated the value which was statistically significant at all probability levels except at 95% level for maxillary canine and premolars. It overestimated for mandibular teeth at 95% and 85% level. The difference was statistically insignificant at 85% level.

Linear regression equations and correlation coefficient were performed to predict the combined width of canine and premolars on maxilla and mandible using combined width of mandibular incisors. Regression parameters are summarized in table 4. The constants for linear regression equations ($y = a + bx$) for prediction in this study are following:

For LCW

$$Y = 8.59 + 0.563x \text{ (female)}$$

$$Y = 3.903 + 0.763x \text{ (male)}$$

For UCW

$$Y = 12.733 + 0.413x \text{ (female)}$$

$$Y = 12.159 + 0.453x \text{ (male)}$$

Table 1: Descriptive Statistics for combined width of lower incisors, combined width of canine and premolars in maxilla and mandible

Variables	Gender	Mean	SD	P value
CWI	M	24.83	1.32	0.000*
	F	23.83	1.79	
	M+F	24.329	1.65	
UCW	M	23.397	1.01	0.000*
	F	22.574	1.32	
	M+F	22.99	1.24	
LCW	M	22.847	1.25	0.000*
	F	21.998	1.43	
	M+F	22.42	1.40	

* = significant

Table 2: The difference (in mm) between the mean values of actual sum of maxillary permanent canine and first and second premolars of Nepalese Newar and those predicted from Moyers charts for the same subjects.

Gender	Probability %	Mean (Actual – Predicted)	SD	SEM	95% CI	Sig. (2-tailed)
Combined	95	-0.145	1.031	0.093	-0.328 – 0.038	0.120
	85	0.4759	1.043	0.0937	0.29044 – 0.661	0.000*
	75	0.80	1.045	0.0938	0.617 – 0.988	0.000*
	65	1.081	1.062	0.095	0.892 – 1.269	0.000*
	50	1.434	1.075	0.097	1.243 – 1.625	0.000*
	35	1.812	1.081	0.097	1.619 – 2.004	0.000*
	25	2.085	1.095	0.098	1.890 – 2.279	0.000*
	15	2.424	1.108	0.099	2.227 – 2.621	0.000*
Male	5	3.014	1.136	0.102	2.812 – 3.216	0.000*
	95	-0.37	0.904	0.116	-0.602 – -0.138	0.002*
	85	0.176	0.897	0.115	-0.054 – 0.4058	0.131
	75	0.476	0.897	0.115	0.246 – 0.706	0.000*
	65	0.72	0.902	0.115	0.489 – 0.951	0.000*
	50	1.020	0.902	0.115	0.789 – 1.25	0.000*
	35	1.376	0.897	0.115	1.146 – 1.606	0.000*
	25	1.62	0.902	0.115	1.389 – 1.851	0.000*
Female	15	1.92	0.902	0.115	1.689 – 2.151	0.000*
	5	2.437	0.889	0.114	2.209 – 2.664	0.000*
	95	0.073	1.105	0.139	-0.206 – 0.351	0.603
	85	0.766	1.098	0.138	0.489 – 1.043	0.000*
	75	1.119	1.086	0.137	0.845 – 1.392	0.000*
	65	1.429	1.094	0.138	1.154 – 1.705	0.000*
	50	1.835	1.083	0.136	1.562 – 2.107	0.000*
	35	2.235	1.083	0.136	1.962 – 2.507	0.000*
25	2.535	1.083	0.136	2.262 – 2.807	0.000*	
15	2.912	1.076	0.136	2.641 – 3.183	0.000*	
5	3.573	1.072	0.135	3.303 – 3.843	0.000*	

Table 3: The difference (in mm) between the mean values of actual sum of mandibular permanent canine and first and second premolars of Nepalese Newar and those predicted from Moyers charts for the same subjects.

Gender	Probability %	Mean (Actual – Predicted)	SD	SEM	95% CI	Sig. (2-tailed)
Combined	95	-1.032	0.866	0.078	-1.186 – 0.878	0.000*
	85	-0.299	0.365	0.078	-0.452 – -0.145	0.000*
	75	0.132	0.877	0.787	-0.023 – 0.288	0.096
	65	0.468	0.872	0.078	0.313 – 0.623	0.000*
	50	0.939	0.883	0.079	0.782 – 1.096	0.000*
	35	1.389	0.872	0.078	1.234 – 1.544	0.000*
	25	1.727	0.883	0.079	1.570 – 1.884	0.000*
	15	2.166	0.873	0.078	2.011 – 2.321	0.000*
Male	5	2.890	0.885	0.079	2.733 – 3.047	0.000*
	95	-1.139	0.836	0.107	-1.353 – -0.925	0.000*
	85	-0.399	0.849	0.109	-0.617 – -0.182	0.001*
	75	0.025	0.852	0.109	-0.194 – 0.243	0.822
	65	0.351	0.85	0.108	0.136 – 0.566	0.002*
	50	0.825	0.852	0.109	0.606 – 1.042	0.000*
	35	1.261	0.849	0.109	1.043 – 1.478	0.000*
	25	1.6	0.849	0.109	1.383 – 1.818	0.000*
Female	15	2.051	0.859	0.11	1.831 – 2.271	0.000*
	5	2.751	0.859	0.11	2.531 – 2.971	0.000*
	95	-0.929	0.889	0.112	-1.153 – -0.705	0.000*
	85	-0.200	0.878	0.110	-0.421 – 0.020	0.074
	75	0.236	0.895	0.113	0.011 – 0.461	0.040*
	65	0.582	0.894	0.113	0.357 – 0.807	0.000*
	50	1.050	0.905	0.114	0.822 – 1.278	0.000*
	35	1.514	0.882	0.111	1.292 – 1.736	0.000*
25	1.850	0.905	0.114	1.622 – 2.078	0.000*	
15	2.277	0.878	0.111	2.056 – 2.499	0.000*	
5	3.025	0.895	0.113	2.799 – 3.250	0.000*	

Table 4: Regression parameters for prediction of buccal segment widths.

Arch	Gender	r	r ²	a	B	SEE	P value
Maxillary Arch	M	0.59	0.35	12.159	0.453	0.81969	0.000*
	F	0.56	0.313	12.733	0.413	1.104	0.000*
	M+F	0.61	0.378	11.707	0.464	0.984	0.000*
Mandibular Arch	M	0.81	0.647	3.903	0.763	0.74883	0.000*
	F	0.71	0.502	8.590	0.563	1.013	0.000*
	M+F	0.77	0.589	6.534	0.653	0.903	0.000*

DISCUSSION

Mixed dentition analysis is very important in orthodontic diagnosis and treatment planning as it helps to assess the degree of crowding or spacing that would occur by predicting the width of unerupted permanent canine and premolars. Various methods have been developed to predict width of unerupted canine and premolars among which Moyer's analysis is more commonly used.

This study confirmed other studies^{9,11,15-17} that teeth in male were larger than that of female. Combined width of lower incisors, combined width of canine and premolars on both arches also showed statistically significant sexual dimorphism with males having greater value as found by Burhan et al and Diagne et al,^{9,18} whereas disagrees with Yuen et al¹⁹, who found combined lower incisors width to be greater in female than in male though the difference was not clinically significant. This may be due to racial variation in the mesiodistal width of teeth which has been confirmed by various studies.^{15,20-23}

Both male and female showed higher correlation between sum of lower incisors width and sum of canine and premolars width in both arches, male having higher correlation than female and correlation was higher in mandible than in maxilla (for maxilla $r=0.59$ for male and 0.56 for female, for mandible $r=0.81$ for male and 0.71 for female, $p<0.001$). Some studies have found higher correlation in female for both arches^{8,10} and some have found higher correlation in male.^{17,19}

The difference between actual and predicted width of canine and premolars of male using Moyer's probability table was statistically significant in all probability levels except at 85% level for maxilla and 75% for mandible, and also for female it was statistically significant in all levels except at 95% level for maxillary and 85% level for mandibular canine and premolars. This shows that

Moyer's probability table can be used for estimating the combined width of canine and premolars for Nepalese Newars but at 85% probability level for maxilla and 75% for mandible in male and at 95% probability level for maxillary and 85% for mandible in female, despite the suggestion of Moyer to use the table at 75% probability level. Similarly, previous studies^{8,9,16,17} on different population also found the Moyer's table useful at probability levels other than 75%.

Jaiswal et al¹⁰ found Moyer's prediction table to be inaccurate in Nepalese population, and Gyawali et al¹¹ also found the table not applicable in Nepalese Brahmins and Chhetris. These studies compared their data with the Moyer's prediction table at 50% and 75% probability levels only. Moyer's prediction table predicts the combined mesiodistal width of canines and premolars at various probability table. Although at 50% probability level values distribute normally towards spacing and crowding, Moyer has suggested to use 75% probability level since crowding is more serious problem and 75% level protects the clinician on safe side. Our study compared the data at all probability level and suggested that the table can be used in Nepalese Newar population at different probability level for male and female and for maxilla and mandible.

CONCLUSION

Moyer's probability table can be used to predict combined mesiodistal width population at 85% level for maxilla and at 75% level for mandible in male, at 95% probability level for maxilla and at 85% probability level for mandible in female. The regression equation derived in this study can also be used to predict the combined width of upper and lower permanent canine and premolars for both male and female Nepalese Newar.

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